CONTOUR PICK-UP AND REGISTRATION OF INFRARED IMAGES OF PALM

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Abstract - **In this thesis an approach of Contour Pick-up and image registration is presented for infrared images of palm. Contour Pick-up is based on Gauss-Laplase kernel and image registration is implemented by their cross-correlation function. In order to use the temperature variety attained from the infrared images for diagnoses of metabolically diseases, man used to get the different time temperature of a certain area artificial point by point. It always wastes time and the data cannot be very accurate. This Thesis gives a method that avoids these disadvantages. First, the contour is picked up from the environment by using the convolution of Gauss-Laplase kernel. Then we filled inside the edge with darkness. Counting the max value of their cross-correlation function realize registration of the infrared images of palm. The results of experiment prove this method to be feasible.**

*Keywords-***infrared images, palm, contour pick-up, image registration**

I INTRODUCTION

Infrared Thermograph is used to measure the temperature distributing of a body. The infrared images it generates can be used to diagnose metabolically diseases. Those diseases can cause abnormity of metabolism For example inflammation, cancer, knob, diabetes mellitus can all bring temperature variety effect. The diagnosis of galactophore oncosis with infrared images has been successfully used in clinic. All this provides us feasibility of using infrared images of palm for diagnoses of metabolically diseases.

In the experiment, we adopt palm –coldwater-loading method. At the different time before loading and of temperature restoring stage, infrared images will be taken to the palms of the person in the experiment to observe the temperature restoring condition after loading. (In the infrared images, the intensity information will be transmuted into temperature information through some reflect.) Because the position and posture of the palms and the splaying of the fingers of the same person in the experiment are different at different time, it is difficult to determine the correspond position of the palm at different time on the picture.

In order to study the temperature restoring condition, man have to check the temperature of a certain area artificial point by point with the traditional method. It always wastes time and the data cannot be very accurate [1]. The method this thesis presented avoids these disadvantages. It use the convolution of Gauss-Laplase kernel to pick up the contour of a palm, then fill inside the edge and implement registration by counting the max value of their cross-correlation function.

II METHODS

The Laplacian is a scalar second-derivative operator for functions of two dimensions. It is defined as:

$$\nabla^2 f(x,y) = \frac{\partial^2}{\partial x^2} f(x,y) + \frac{\partial^2}{\partial y^2} f(x,y) \tag{1}$$

For digital image processing, it is always implemented by the convolution kernels. “x” for the horizontal direction and “y” for the vertical direction.

Since it is a second derivative, the Laplacian will produce an abrupt zero-crossing at an edge .The Laplacian is a linear, shift-invariant operator, and its transfer function is zero at the origin of frequency space. Thus, a Lapolacian-filtered image will have zero mean gray level.

If a image has sharp edges, the Laplacian can find them. The binary image that results from thresholding a Laplacian-filtered image at zero gray level will produce closed, connected contours when interior points are eliminated.

In order to remove the noise, imposes a uirement for

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Abstract

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lowpass filtering before using the Laplacian. We choose a Gaussian lowpass filter for this pre-smoothing. The response function of the two dimensions Gaussian filter is defined as:

$$G(x,y)=\frac{1}{2ps^{2}}\ell^{-\frac{x^2+y^2}{2s^2}} \tag{2}$$

Since convolution is associative we can combine the Laplacian and Gaussian impulse responses into a single Laplacian of Caussian kernel.

$$\nabla^2 G(x,y)=\frac{1}{2ps^{4}}\left(\frac{x^2+y^2}{s^{2}}-2\right)\ell^{-\frac{x^2+y^2}{2s^2}} \tag{3}$$

This impulse response can be implemented efficiently in x and y directions separately. The two dimensions convolution can be converted to two single one-dimension convolutions for computer implementation.

When using the convolution on the palm infrared images, the Laplacian can find the edges then produce closed, connected contours of palm results from thresholding the filtered images at zero gray level. With the purpose of registering the contours, we filled inside the edge with darkness.

In order to study the temperature resume of a palm, the images of palm contours must be registered. Suppose g(m, n) represents the model image and f(m, n) stands for the image to be registered. Their cross-correlation function f_{fg} is given by the convolution of f(m, n) and g(-m, -n):

$$f_{fg}(i,j)=\sum_m\sum_n f(m,n)g(m-i,n-j) \tag{4}$$

"i" signifies the horizontal relative coordinate between the model image and the image to be registered.

"j" signifies the vertical relative coordinate between the model image and the image to be registered.

This function indicates the relative degree to which two functions agree for various amounts of misalignment. For the reason that the convolution can be implemented easier in frequency space, we use the Fourier transform of it, which is called as cross power spectrum:

$$f_{fg}(k,l)=F(k,l)G^{*}(k,l) \tag{5}$$

Here $f_{fg}(k,l)$ represents the Fourier transform of $f_{fg}(i,j)$ and $F(k,l)$ represents the Fourier transform of $f(m,n)$, while the $G^{*}(k,l)$ represents the conjugate Fourier transform of $g(m,n)$.

When the value of this function gets the max value, it indicates that the images have aligned. The other images now shift horizontal and vertical on the model image. During this we compute the values of their cross-correlation function. Then we find out the max value and record the relative coordinate of x and y directions. This relative coordinate will be used to get the different time temperature of a certain point or area from infrared images of palms.

III RESULTS

These are the original infrared images we obtained from Infrared Thermograph at different time.

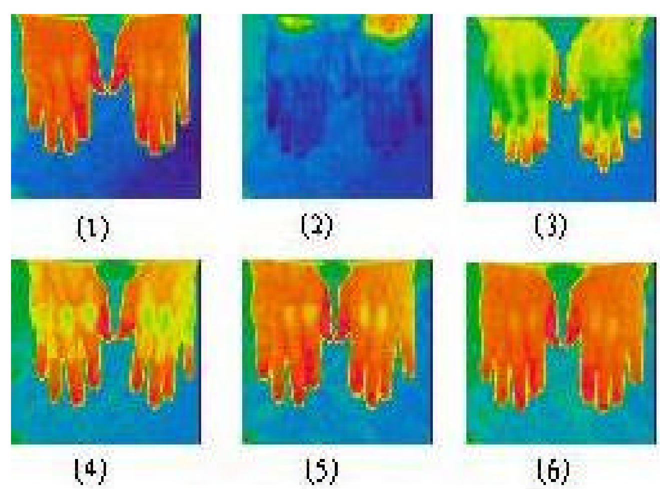

Fig1 the original images we obtained from Infrared Thermograph

The subsequent pictures show the process of contour extraction and images registration. After extract the contour from environment, we filled inside the edge with darkness. Here we use a single palm to show the principle of this thesis. All the infrared images of palms can be registered similarly.

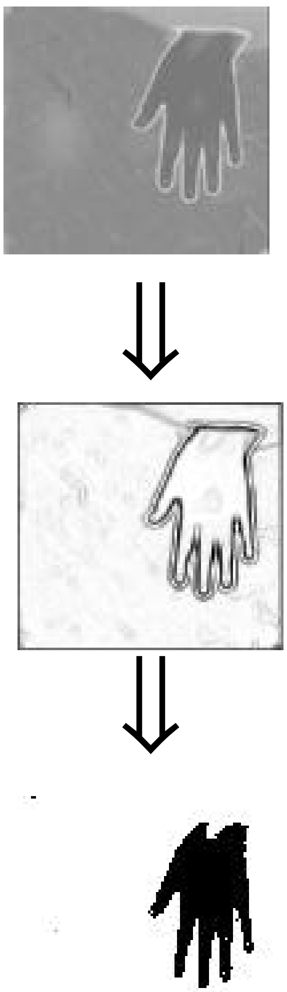

Fig2 the process of contour pick-up of model infrared image of palm.

When using the same method on the image to be registered, we attained the following pictures.

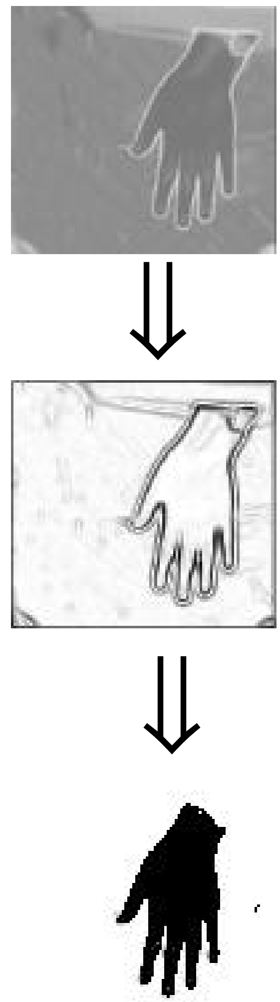

Figure3: the infrared image of palm to be registered

After this, the image to be registered moves horizontally and vertically on the model image. Then we compute the max value of their cross-correlation function and record the relative coordinate of x and y directions (i , j). The result shows that the images registered quite well.

The subsequent pictures are model image, image to be registered and the registered image in sequence.

Fig.4 the results of registered palms

IV. DISCUSSION & CONCLUSION

The mean temperature of a palm can be obtained by counting the points inside the contour of a palm:

$$\overline{Q} = \sum_{X} \sum_{Y} Q(x, y) \qquad (6)$$

Q(x, y) represents the distributing function of the palm temperature. We think this parameter is useful for observing the temperature restoring.

In the above paragraphs, we adopted the function (5) for registration:

$$f_{fg}(k,l) = F(k,l)G^{*}(k,l)$$

In order to give prominence to the contour during registration, the above function seems better to be changed to [3]:

$$H(k,l) = (k^{2} + l^{2})G^{*}(k,l)\,. \qquad (7)$$

From the results of our experiment, the method based on Gauss-Laplase kernel and cross-correlation function is proved to be briefly and practicable for contour pick-up and registration of infrared images of palm. Of course it can be used for other similar images.

V. REFERENCE

[1] Atsumi K., Medical thermo grapy, Tokyo University of Tokyo Press, 1973.

[2] G.S. Garrett, E.L. Reagh, E.B. Hibbs, Jr., Detection Thresholding Estimation for Digital Area Correlation. IEEE Trans. SMC-6, 65-70 (1976).

[3] H.C.Andrews, Automatic Interpretation and Classification of Images by Use of the Fourier Domain. Academic Press, New York, London

[4] F.Maes, A.Collignon, et al., IEEE Trans.Medical Imaging, 16(2), 1997

[5] W.M.I.Wells, P.Viola, et al., Medical Image Analysis 1,1996

[6] Alan V.Oppenheim Alan S. Willsky with S. Hamid Nawab, Signals and Systems. Prentice Hall, 1997 (Chapter 5).

[7] K.R. Castleman, Digital Image Processing, Prentice Hall, 1996 (Chapter 10.5.3).